

# Wet Bulb Globe Temperature provision in the National Digital Forecast Database (NDFD)

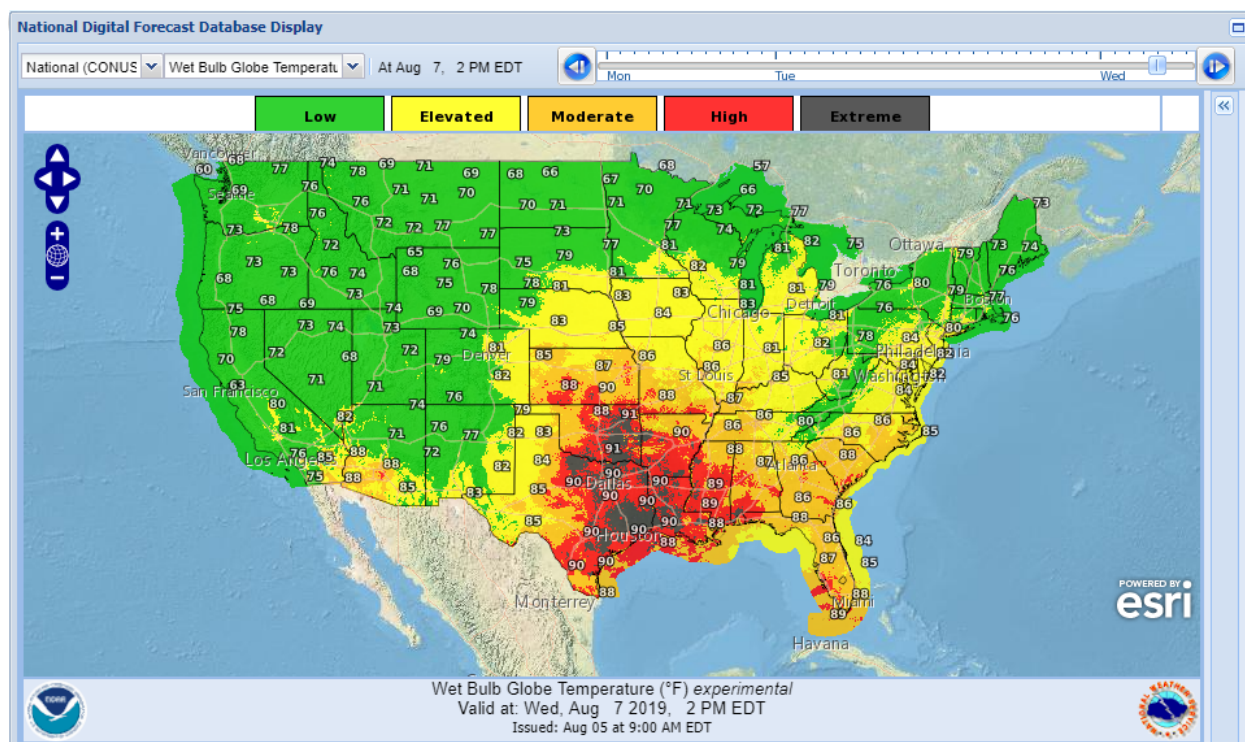
## Product Description Document

### May 2022

#### Part I – Mission Connection

A. **Product Description** – Wet Bulb Globe Temperature (WBGT) grids are available in the National Digital Forecast Database (NDFD) on an operational basis. This element is available for the Continental United States (CONUS), Hawaii, Guam and Puerto Rico. WBGT is automatically derived from existing Weather Forecast Office (WFO) NDFD grids, and is calculated hourly to 36 hours, three-hourly to 72 hours; and six-hourly to 168 hours.

B. **Purpose** – WBGT is a composite parameter that estimates the effect of temperature, humidity, wind chill, and solar radiation on humans. If you work or exercise in direct sunlight, WBGT is an effective means of assessing heat stress to persons involved in outdoor physical activity. WBGT has become a highly used parameter by partners, particularly emergency managers, in Impact-based Decision Support Service (IDSS) activities. The Heat Index product is useful for sedentary populations as it is calculated for shady areas. However, it does not appropriately address Exertional Heat Illness (EHI) and Exertional Heat Stroke (EHS) threats for physically active outdoor communities.



C. **Audience/Users** – The audience for the NDFD WBGT grid includes a large volume of users of weather decision support information including emergency managers, military, athletic associations, recreational users, the media, numerous local, state, and federal government agencies (including NWS field offices), academia, and many other groups.

D. **Presentation Method** – As with all NDFD elements, these elements are available in Gridded Binary Data Edition 2 (GRIB2) via file transfer protocol (ftp) or hypertext transfer protocol (https), eXtensible Markup Language (XML), and as graphics via web browser.

1. GRIB2 format at 2.5 km horizontal grid spacing, via file transfer protocol (ftp) or hypertext transfer protocol (https): The GRIB2 files can be decoded and converted to other formats, such as shape files, netCDF files, etc. [Click here](#) for more information.
2. Extensible Markup language (XML): Users can request NDFD elements over the Internet using the NDFD XML Simple Object Access Protocol (SOAP) server. The response to the user request is returned in XML format. For more information, please refer to the [NDFD XML Service Description Document](#).
3. Online NDFD graphics: WBGT and other NDFD elements can be accessed on the [NDFD page](#).

E. **Feedback Method:**

WBGT has been experimental from 2019 to 2021, with a formal public comment period from August 23, 2019 to September 30, 2020.

Questions related to WBGT can be directed to:

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For general questions regarding the National Digital Forecast Database, please email:  
[nws.ndfd@noaa.gov](mailto:nws.ndfd@noaa.gov).

## **Part II - Technical Description**

A. **Format & Science Basis** – The NDFD forecast element definitions and technical information (e.g., temporal and spatial resolution of the graphics, and geographic coverage) may be found on the NDFD technical page at the following URL:

[https://www.weather.gov/mdl/ndfd\\_home](https://www.weather.gov/mdl/ndfd_home).

The scientific basis for generating forecasts of WBGT from weather element forecasts routinely produced by WFOs for NDFD is described by Dimiceli and Piltz (2013). The authors employed an algorithm from the Occupational Safety and Health Administration to compute WBGT:

$$WBGT = 0.7NWB + 0.2BGT + 0.1DB$$

Where NWB = Natural Wet Bulb Temperature

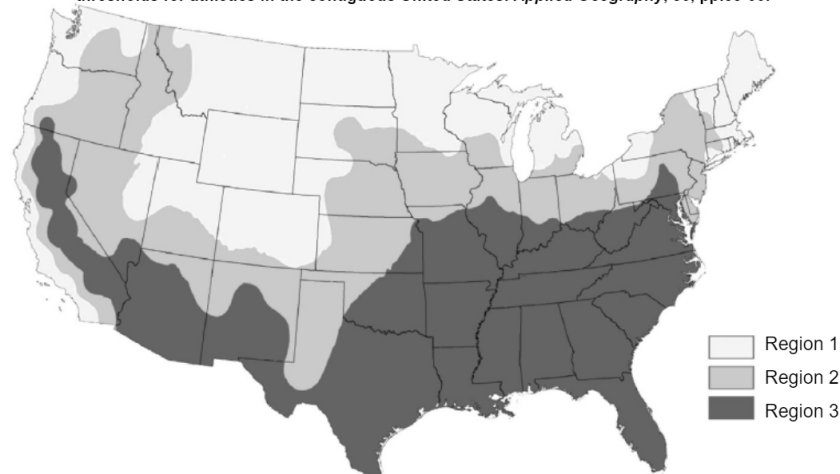
BGT = Black Globe Temperature

DB = Dry Bulb Temperature

The forecast for the natural wet bulb temperature is computed from NDFD forecast data and equations that estimate incoming solar radiation flux. Dry bulb temperature forecasts come from NDFD 2-meter surface temperature forecasts. Additionally, an equation was derived by which the black globe temperature forecast can be estimated from standard NDFD forecast data and estimated incoming solar radiation. For more information how WBGT is calculated through NDFD, please refer to the following [White Paper](#).

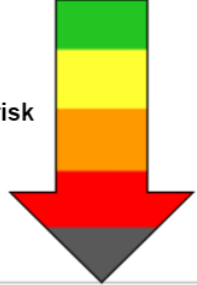
The heat stress categories produced through WBGT forecast values vary by region to account for geographic variations in heat exposure and acclimatization. Following are images of the geographic regions for CONUS, and threat level color scale with the WBGT value broken down by region. No matter what region you are located, the higher the wet bulb globe temperature, the higher the risk for heat illness.

Regions are adapted from Grundstein, A., Williams, C., Phan, M and Cooper, E., 2015. Regional heat safety thresholds for athletics in the contiguous United States. *Applied Geography*, 56, pp.55-60.



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Disclaimer: Always check with local officials for appropriate actions and activity levels. Experienced heat stress will depend upon duration and intensity of activity and personal health and vulnerability.

WBGT by Region (°F)			Threat Level WBGT at these values increasing heat stress.	Risk of heat illness
Region 1	Region 2	Region 3		
< 72.3	< 75.9	< 78.3	Low Threat	<div>Increased risk for heat illness</div> 
72.3 - 76.1	75.9 - 78.7	78.3 - 82.0	Elevated Threat	
76.2 - 80.1	78.8 - 83.7	82.1 - 86.0	Moderate Threat	
80.1 - 84.0	83.8 - 87.6	86.1 - 90.0	High Threat	
>84.0	>87.6	>90.0	Extreme Threat	

Regions are from Grundstein, A., Williams, C., Phan, M and Cooper, E., 2015. Regional heat safety thresholds for athletics in the contiguous United States. *Applied Geography*, 56, pp 55-60. 10.1016/j.apgeog.2014.10.014.

B. **Product Availability** – NDFD WBGT forecasts are available via file transfer protocol (ftp) or via hypertext transfer protocol (https). For further availability and technical information (e.g., temporal and spatial resolutions, forecast projections, and geographic coverage) please visit the following URL: <https://vlab.noaa.gov/web/mdl/ndfd-grid-data>.

C. **Additional Information** – For more information on the NDFD, please refer to the NDFD Information web site at the following URL: <https://vlab.noaa.gov/web/mdl/ndfd>